Disk Sector and Disk Support Ring Status

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Topics

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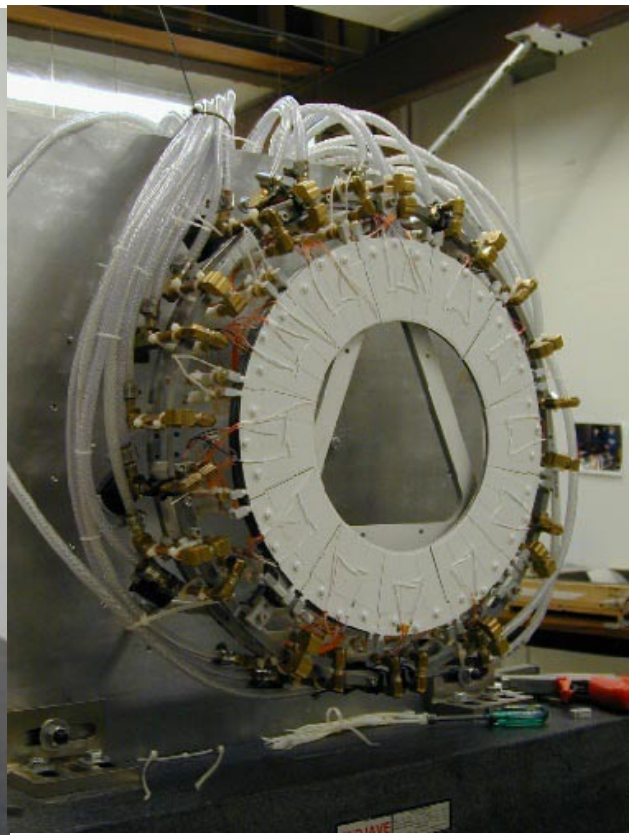
ESLI and HYTEC Prototype Disk

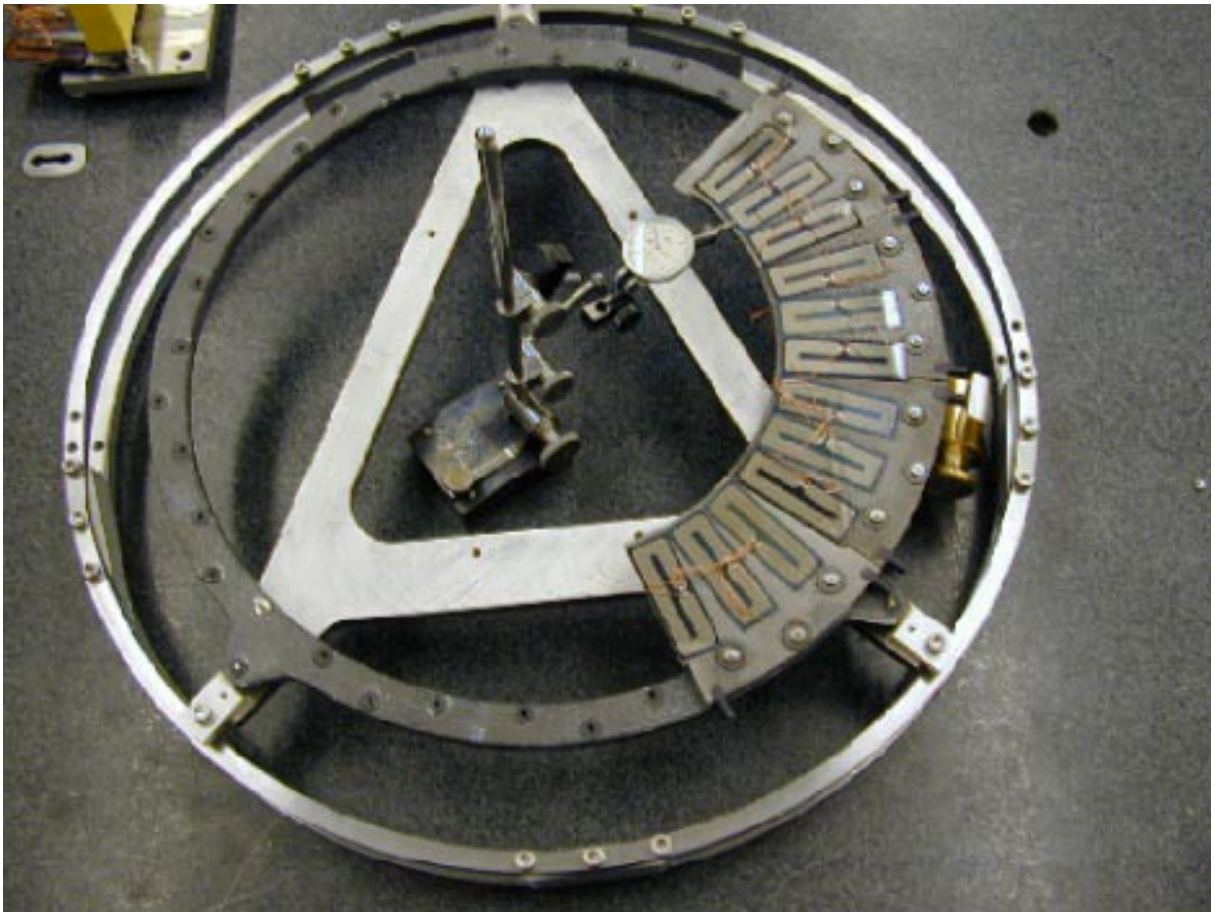
The ESLI and HYTEC prototype disk was assembled. The disk consist of 12 ESLI all carbon sectors and a HYTEC fabricated sector support ring. The average radiation length of the sectors in the active region is 0.57%. Coolant, power, and sensor connections have been made. Techniques for precision attachment of mounting points and for attachment of coolant tube end pieces have been developed. Two sectors were found to have leaks. Seventy-two dummy silicon modules were mounted on the sectors with CGL7018.



ESLI and HYTEC Prototype Disk Deformations

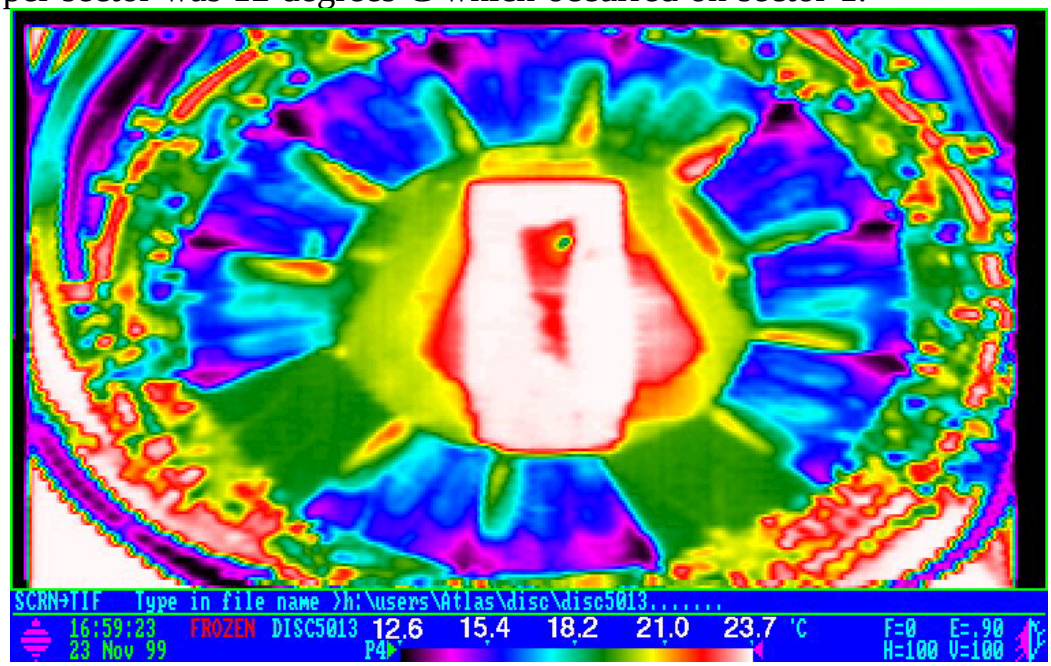
Deformations of sectors and the disk support ring have been measured using simulated coolant tube forces. Weights were hung from various coolant inlet or exhaust tubes and the movement perpendicular to the plane of the disk was measured for various sectors at their inner radii. The sag of the support ring at the center of the longer arc was the cause of the largest deformation. The tilting of a sector resulted in an approximately 25 μ motion of the sector's inner radius for a 500 g weight hung at a lever arm of approximately 18 mm. The disk support ring is being redesigned for increased stiffness.

Measured Sector	Movement	Weight Location	Weight
Sector 5	13 μ up	Sector 2, 5:30	200g
Sector 5	28 μ up	Sector 2, 5:30	500g
Sector 5	8 μ down	Sector 7, 6:30	200g
Sector 5	20 μ down	Sector 7, 5:30	500g
Sector 2	101 μ down	Sector 2, 2:30	500g
Sector 2	132 μ down	Sector 3, 2:30	500g
Sector 2	76 μ down	Sector 4, 3:30	500g

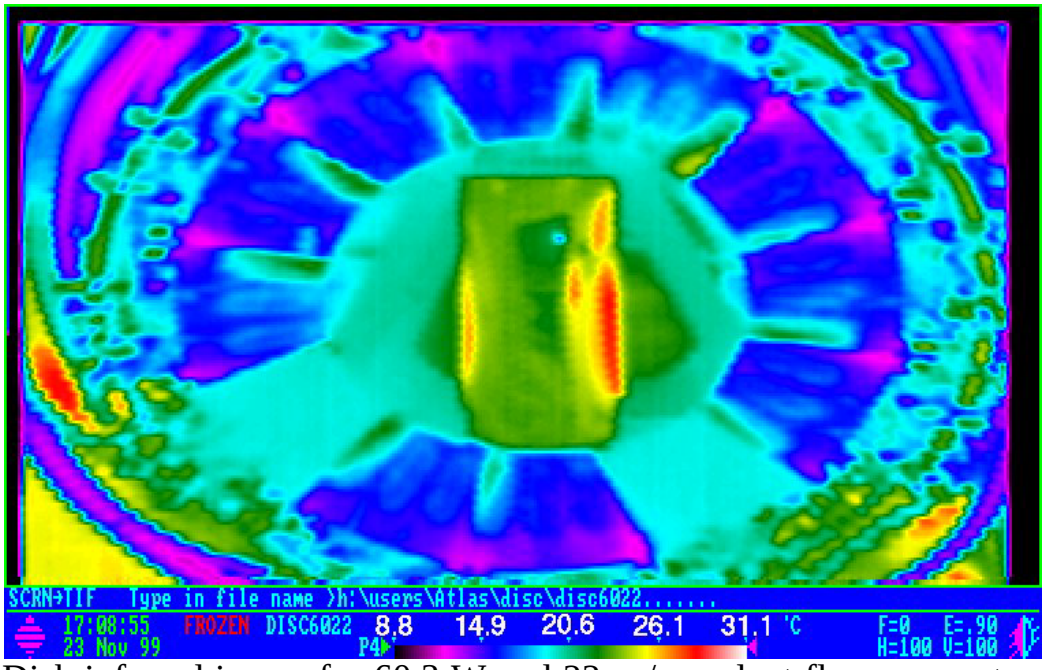


ESLI and HYTEC Prototype Disk Thermal Test

The thermal performance of ten of the sectors was measured with Infrared Imaging and RTDs. Water at an approximate inlet temperature of 11 degrees C was the coolant fluid. The maximum observed temperature increase for 50.5 Watts per sector was 12 degrees C which occurred on sector 1.



Disk infrared image for 50.5 W and 13 cc/s coolant flow per sector.

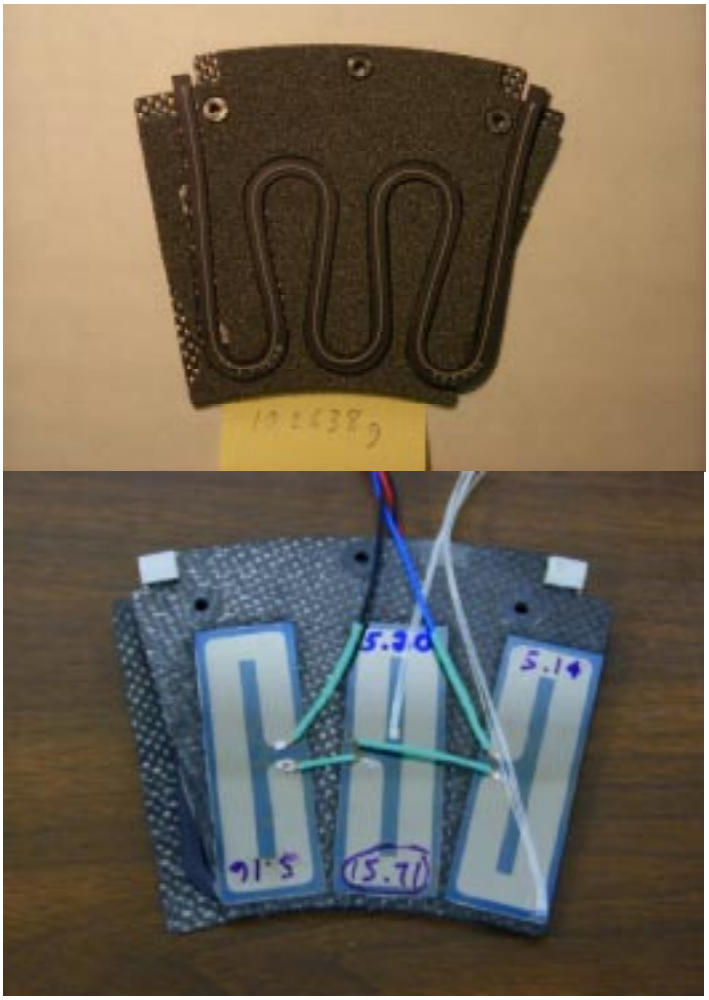


Disk infrared image for 60.3 W and 22 cc/s coolant flow per sector.

Aluminum Tube Sector 5’

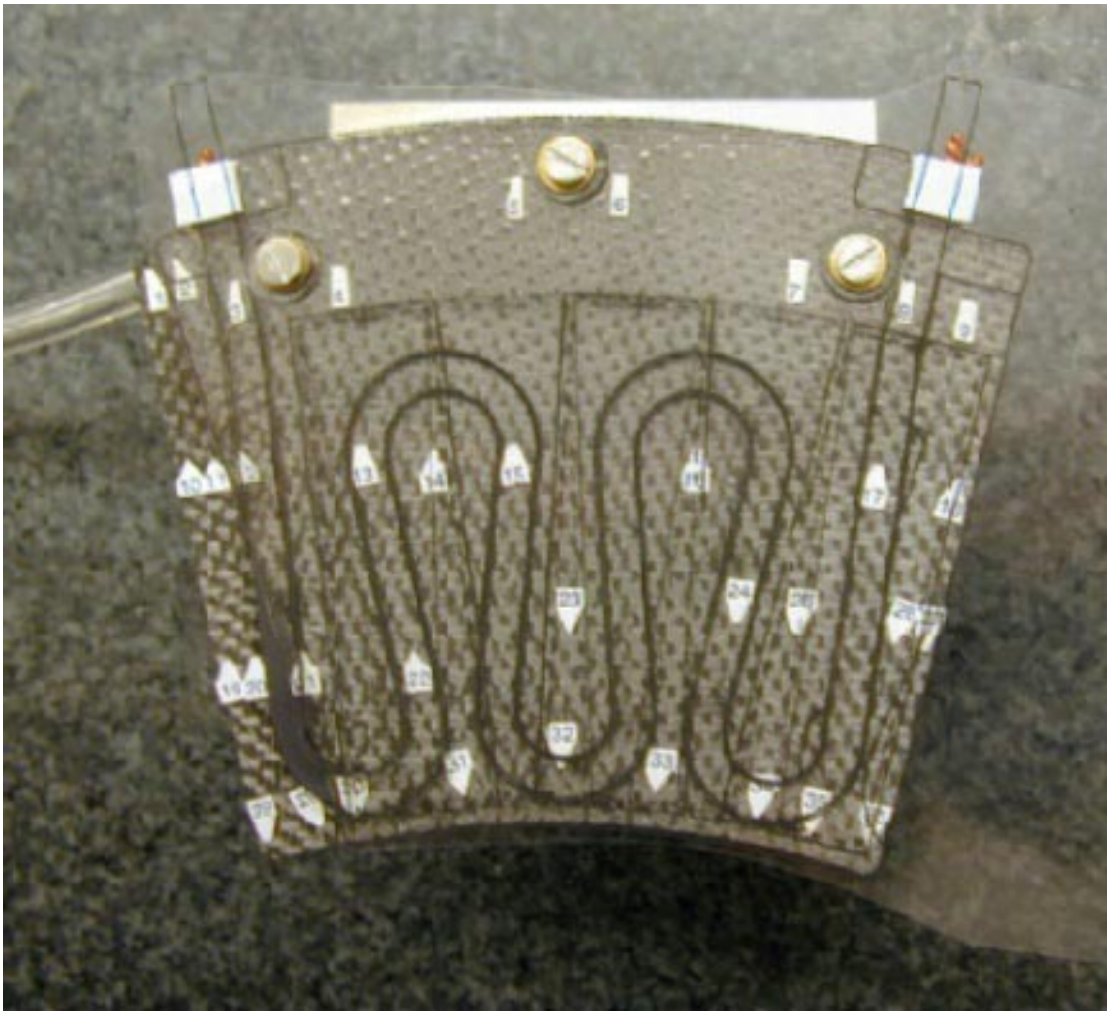
Aluminum tube sector 5 has been reborn. Prototype 5’ uses a rectangular cross section aluminum tube versus the flattened round tube of aluminum tube sector 4. The aluminum tube was anodized to increase resistance to aluminum-carbon corrosion. Glass beads of 50 to 75 microns in diameter were imbedded in the CGL7018 thermal compound used between the aluminum tube and the carbon-carbon facings.

Tube:	Rectangular aluminum 0.20 mm wall thickness
Facings:	Carbon-carbon facings 0.30 mm thick
Fill:	CVD densified RVC foam and C-C hard points
Thermal Adh.	AI Technology CGL7018
Structural Adh.	Bryte Technology cyanate ester sheet
Radiation Length	0.54% in active region, 0.56% for entire sector
Hydraulic Diam.	0.24 mm (to increase to 3.3 mm adds 0.03% Rad. Len.)



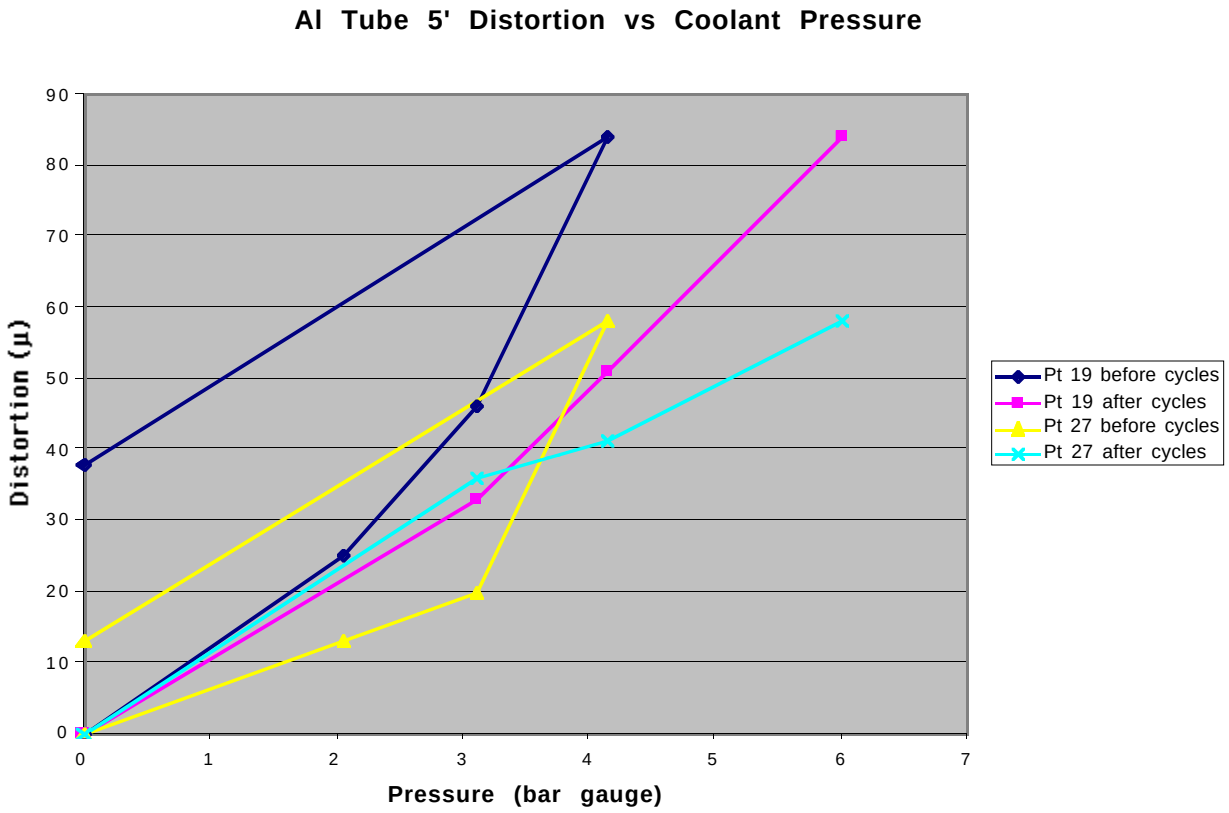
The planarity of Aluminum Tube sector 5 was measured. The rms planarity of each side is approximately 15 microns.

Al Tube Sector 5’ without dummy silicon modules:
Z Distortion versus Coolant Pressure at room temperature



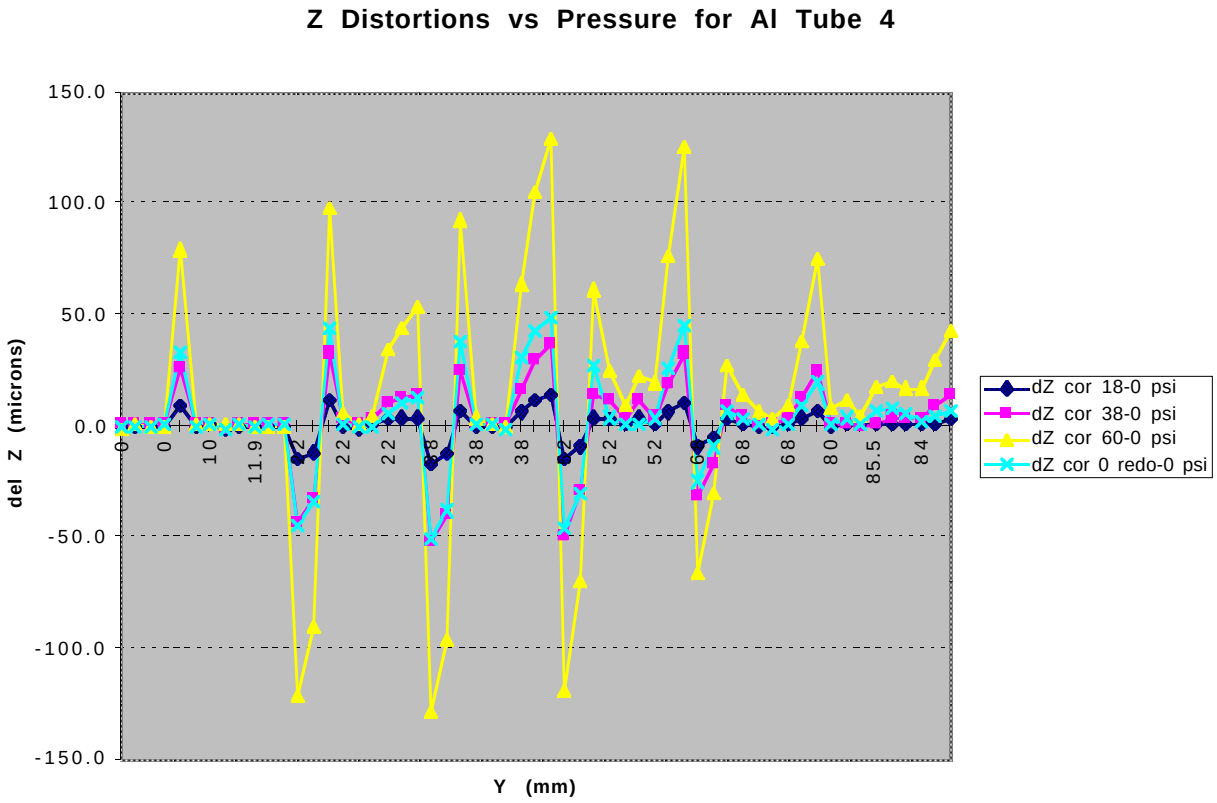
Above is a photograph of aluminum tube sector 5’ showing the locations at which out-of-plane distortion measurements were taken as a function of coolant pressure above atmospheric (gauge pressure). In general, points on the facing overhangs distorted 25 to 80 μ at the highest pressure (6.0 bar gauge) while points in the central region distorted less than 15 μ at the highest pressure. Data were taken at pressures to 4.1 bar gauge after which the pressure was cycled 140 times between 0 and 4.1 bar gauge (5 minutes off, 5 minutes on). Data were then taken at coolant pressures to 6.0 bar gauge

Al Tube Sector 5’ without dummy silicon modules:
Z Distortion vs Coolant Pressure at room temperature



Distortions for the two points with the largest deformations are plotted as a function of the pressure in the coolant tube above atmospheric pressure (gauge pressure). These points are on the edges of the facing overhangs. Data are plotted for distortions before and after pressure cycling. Data point 19, the point displaying the largest distortion, had a residual distortion after the first pressure test of 38 μ, which remains unchanged after pressure cycling. Less distortion is observed as a function of pressure after the initial residual distortion has been induced. Aluminum tube sector 5’ meets our requirements for distortion up to 4 bars absolute pressure and shows no damage when pressurized to 7 bars absolute.

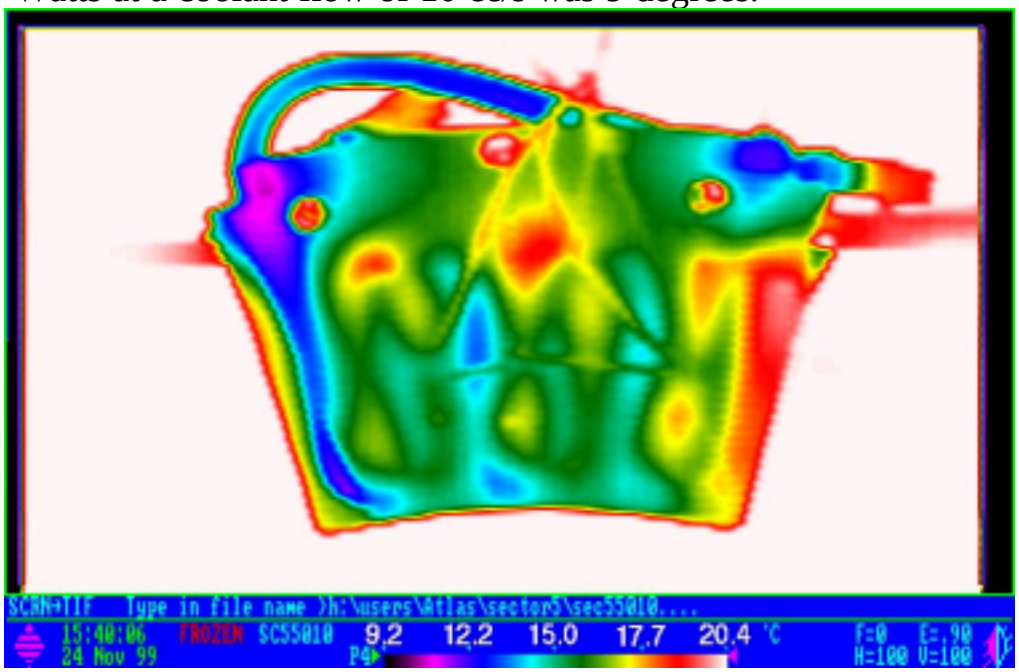
Al Tube Sector 4 without dummy silicon modules: Z Distortion vs Coolant Pressure at room temperature



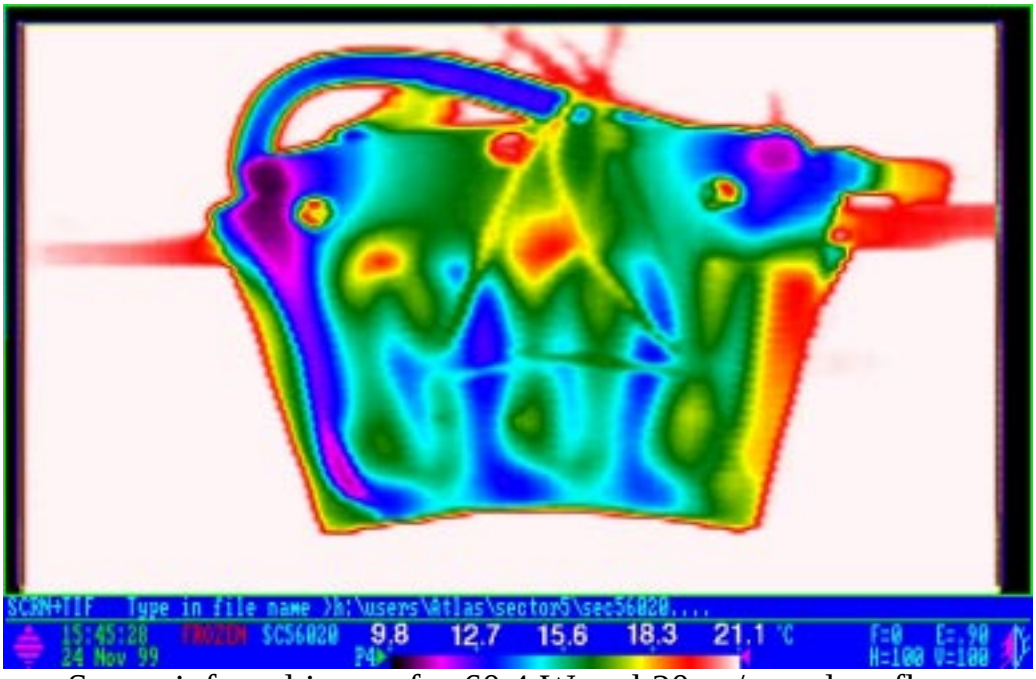
Distortion is plotted as a function of the radial distance from the outer radius of the sector. The variation of the distortion as a function transverse to the radial dimension is included but not identified. Coolant pressures were varied from 0 to 4.1 bar (60 psi) above atmospheric pressure. Maximum distortion is approximately 130 microns with a residual distortion of approximately 50 microns. Almost all distortion occurs on the facing overhangs.

Aluminum Tube Sector 5’ Thermal Test

The thermal performance of Aluminum Tube Sector 5’ was measured with Infrared Imaging and RTDs. Water at an approximate inlet temperature of 11 degrees C was the coolant fluid. The maximum observed temperature increase for 49.5 Watts at a coolant flow of 10 cc/s was 9 degrees.



Sector infrared image for 49.5 W and 10 cc/s coolant flow.



Sector infrared image for 60.4 W and 20 cc/s coolant flow.

Summary and Plans

Prototype Disk:

First prototype disk with test equipment has been assembled.

Two of twelve sectors leak.

ESLI sectors pass thermal tests with liquid coolant.

Shape and distortion test to continue on CMM.

Disk support ring being redesigned.

Aluminum Tube Sector:

Aluminum tube sector 5’ meets out-of-plane distortion requirements up to a coolant pressure of 4 bars absolute and can withstand up to 7 bars absolute.

Aluminum tube sector 5’ passes thermal tests with liquid coolant.

Shape and distortion test to continue on CMM.

An aluminum tube sector with a thicker tube wall and an increased hydraulic diameter will be fabricated. The radiation length increase will be approximately 0.1%.